

**AC 2008-2735: ELEMENTARY TEACHER PROFESSIONAL DEVELOPMENT IN
ENGINEERING: LESSONS LEARNED FROM ENGINEERING IS ELEMENTARY**

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Elementary Teacher Professional Development in Engineering: Lessons Learned from *Engineering is Elementary*

The *Engineering is Elementary* (EiE, www.mos.org/eie) project aims to foster engineering and technological literacy among children and their educators. EiE is creating a research-based, standards-based, and classroom-tested curriculum that integrates engineering and technology concepts and skills with elementary science topics. EiE materials also connect with literacy, social studies, and mathematics. Through engaging engineering design challenges children are invited to apply their knowledge of science, engineering, and their problem solving skills, as they design, create, and improve possible solutions.

The EiE project also focuses on helping elementary educators enhance their understandings of engineering concepts and pedagogies through professional development programs and resources. Over the past four years as we have created curricular materials, offered a wide range of professional development workshops, solicited extensive teacher and student feedback and evaluation, and observed elementary engineering teaching in classrooms, the EiE project team has learned a great deal about teaching and doing engineering with elementary teachers and students. Eleven EiE staff have offered over 140 professional development workshops for over 2700 teachers in 21 states.

Our learning has evolved over time and stems from a variety of sources of feedback. Experience has been our biggest teacher. The feedback of workshop participants, both formal and informal, is perhaps the most important has been the most important source of data. Educators are generally very honest and articulate about what they found valuable and what they would change. We collect feedback from participants at virtually every professional development session. Our assessment instruments vary depending on the length of the workshop (two hour sessions require different metrics than two weeks of contact) and range from a daily index card dipstick of “What’s hot/What’s not”, to our “standard” workshop evaluation form for a 2-8 hour session (see Appendix A), to a much more extensive online instrument designed to measure content knowledge and classroom implementation for multiple day sessions. Also very important are informal comments, conversations, and email communication that occur throughout the course of planning and offering a workshop. The informal dialogue often surfaces nuances or concerns that are not captured on paper, permits deeper probing and articulation, surfaces fears, and allows ongoing feedback.

The EiE staff members who lead professional development regularly discuss what they have tried, what has worked, what has not, and ongoing challenges. Constructive, critical team and individual reflection and critique have helped us to distill some successful strategies. The paper below captures some of what we have begun to understand. It outlines some of the organizing principles and structures that guide our professional development programs, challenges that we encounter, opportunities that arise, and differences that we have observed between elementary and secondary professional development. However, we still have much more to learn! The EiE team is continually tweaking our existing programs or experimenting with new professional development offerings as we seek to improve and expand our knowledge, programs, and resources.

Organizing Principles & Structures

All Engineering is Elementary professional development workshops share a common backbone. We consider many of the elements to be essential to high-quality professional development (PD).

Consistent Philosophical Underpinnings: The same philosophy of how people learn, one consistent with social constructivism, underlies both the EiE curriculum and professional development. We believe that people learn best by engaging with meaningful activities from which they can develop understandings and skills. Good models and scaffolds—social, material, and conceptual—are key to fostering understanding. Internally, philosophical coherence between the curricular materials and professional development means they are closely intertwined and support one another.

Tailored Program: While EiE workshops generally follow a similar structure, the professional development facilitator considers the needs of the client and the audience to develop a tailor-made program. Virtually no two professional development programs are identical.

Define Goals for Program: Toward the beginning of the workshop, working with participants to identify goals for that program helps to ensure that participants and facilitators are approaching the program with a similar mindset. Often, we revisit these goals at the conclusion of the program to assess how well they were met.

Reasons for Teaching Engineering: Including engineering concepts in elementary classrooms is a new phenomenon. Articulating reasons that elementary teachers might want to modify their existing practices to include engineering provides participants with a larger context in which to set their efforts and tools to explain and advocate this idea to others.

Begin Workshop With An Activity (or Two): The first sessions of an EiE workshop are always activities designed to introduce teachers to technology, each other, and the engineering design process. Our “What is Technology?” activities help teachers understand that technology encompasses more than computers and devices that use electricity; in fact, technologies have existed throughout human history. Our “What is Engineering?” activities engage teachers in designing and constructing a solution to a problem. From a discussion about the steps they used, our five-step EiE Engineering Design Process is distilled and teachers come to realize that they naturally engineer.

Kicking off a session with activities models the kind of teaching we hope will occur in classrooms, demonstrates what engineering looks like at an elementary level and helps to mitigate teachers’ trepidations about engineering as a difficult and unapproachable discipline.

Reduce Anxiety and Barriers: One of the biggest challenges (see next section) to integrating engineering into elementary schools is teachers’ anxiety about this new discipline. Perhaps the most important goal of professional development workshops for elementary teachers is affective—it focuses on reducing teachers’ anxiety and building their self-efficacy with respect to engineering. Helping teachers to understand that they already know engineering concepts (they just have never recognized their knowledge as such), showing them that they can engineer,

and making them feel comfortable and confident so that they can do engineering with their students is an essential pre-requisite to classroom implementation. It is also something best done in a face-to-face workshop setting.

As part of our effort to make engineering seem inviting and approachable, our PD facilitators strive to eliminate or downplay perceived status differences. For example, we try to dress similarly to the participants (generally this is not in suits) and actively acknowledge the expertise of the participants, especially in areas where they know more than the facilitators.

Doing What They'll Do in the Classroom: We have learned that an activity, innovation, or pedagogical strategy is much more likely to be implemented in the classroom if teachers engage with it themselves first. Although our curricular materials have been written so they should not require professional development, the vast majority of teachers much prefer learning about an activity by doing it rather than by reading about it. Our workshops *always* have teachers engage with an EiE unit, doing the lessons. Becoming familiar with the materials and the student handouts helps teachers visualize how they can be used in their classes. It also helps them to understand where students are most likely to have difficulties or need to overcome misconceptions. Additionally, as we engage with a unit's lessons we orient teachers to the general structures of the EiE curriculum unit binders.

Focus on Processes: At the elementary level, our focus is on developing children's understandings of the processes of engineering—not on deep and detailed engineering content. Curricular materials and PD activities focus on building teachers' knowledge that engineers use a process to solve problems—the engineering design process. This process might encompass a number of other science, mathematics, and engineering skills such as visualization, inquiry, data collection, data analysis, modeling, communication, and graphing. In PD sessions we aim to build participants' fluency and comfort with these skills and processes. Elementary teachers enthusiastically embrace the process and often apply it as a unifying problem-solving technique for all the disciplines they teach.

Integration: Based on feedback from teachers and curriculum coordinators, the EiE project is grounded in an approach that aims to integrate engineering with other elementary disciplines and topics. In our PD sessions we highlight the opportunities for integration and demonstrate how engineering can reinforce science, mathematics, social studies, and language arts concepts that students may be concurrently studying.

Real-World Context: All EiE activities—those created for the curriculum as well as PD sessions—are very carefully crafted so they are rooted in a real-world context. Students, as well as teachers, respond to “real” problems that are relevant to their lives and cite this as a main reason for deep engagement with our materials. The problems have participants apply science, mathematics, and other disciplines, thus helping to demonstrate how these academic subjects can be relevant in their lives. In defining context, staff attend very closely to creating problems that will be inviting, accessible, and engaging to women and other underrepresented groups.

Model and Discuss Pedagogical Points: Our PD sessions seek to model the types of engineering pedagogies that we hope to see in a classroom. To help equip teachers to lead their students, we

model such practices in our workshop sessions. We also try to infuse teaching tips and information that will prepare teachers for the classroom. For example, we might call out common student misconceptions, ideas, designs, areas of confusion, or strategies for guiding students through the design process. We have learned that when workshops run smoothly teachers might not notice some of the pedagogical strategies or techniques we employ (e.g., how we manage materials) and we are currently experimenting with ways to draw teachers' attention to these.

Deliberation and Decisions: By design, some of the most interesting elements of our design challenges ask participants to wrestle with a variety of ideas, possible criteria for “success,” and open-ended challenges. As PD providers, we have come to realize that workshops must provide participants the opportunity to grapple with these ill-defined problems, to engage in deliberation, and to come to consensus as a group. While this can be time consuming, it is critical that teachers participate in such activities and develop an appreciation for this type of messy social interaction as a critical piece of the engineering process.

A Social Endeavor: Despite many misconceptions, engineering is a social endeavor and requires extensive teamwork. Furthermore, interesting learning opportunities are presented when people work in groups. Therefore, nearly every EiE activity in class and in PD is done in groups. We've learned that first and second graders can generally only work well in pairs (they don't yet have the social skills for managing more complex social interactions together with more intellectual work) and that the group size can increase to three or four in older grades. Our teacher participants also work in such small groups, sharing and negotiating ideas and solutions.

Teams: We often either require or invite teachers to attend professional development in teams from their school or district. This is to seed a larger group of change agents, distribute the risk of doing something innovative, and to reach beyond the early adopter to teachers who might be less likely to attend programming unless strongly encouraged by a colleague.

Start Small and Develop Local Experts: Other elementary teachers and colleagues from the district or school are a powerful set of mentors and advocates. As much as possible, we try to include practicing teachers who are using EiE materials as facilitators for the workshops—they bring additional credibility and can share tips they have developed with fellow teachers. When working with district-wide adoption, we usually advocate for beginning with a small subset of teachers the first year. After they have engaged in PD and have had a chance to try our materials they can serve as co-PD providers, mentors, and advocates for the program from within the district. Success in the same school or the same district can be some of the most convincing evidence for colleagues.

Evaluation: Our professional development sessions always conclude with an evaluation of the session by the participants. Often additional evaluation occurs later in the school year, after time has elapsed for implementation, with another evaluation instrument that assesses the degree to which the materials were used in the classroom. Evaluation results are analyzed and the feedback and data used to refine programming.

Challenges

During professional development work with elementary educators, we have encountered a number of challenges. Some of these are unique to the discipline of engineering; others apply more generally to professional development. These include:

Engineering as Terrifying: If most elementary teachers are afraid of teaching science, the notion of teaching engineering is often accompanied by terror. Much of the point of our professional development is to defuse their feeling of ineptitude through engagement (see above). However, the fear of engineering and skepticism about its inclusion in elementary classes is most difficult to assuage in the recruitment phase—sometimes workshop registrations are surprisingly low. (Generally our workshops are full.) Although we firmly believe that the term “engineering” should be used in conjunction with engineering activities so students and other people become more familiar and less daunted by it, in such cases of low enrollment one strategy we have successfully employed is to re-advertise the workshop as a “problem-solving” or “design” workshop. The more approachable terms mean that teachers enroll. Once they are in attendance and have engaged in an activity we let them know that what they are really doing is engineering.

Visualizing Elementary Engineering: The image of engineering as something that can only be done by super-smart people coupled with teachers’ lack of previous experience with our models for elementary engineering present perhaps the biggest challenges to elementary engineering curriculum implementation and professional development. On the flip side, the dearth of experience also presents rich opportunities (see below). Teachers have generally never seen or experienced engineering in an elementary classroom and have never taught it to students; their first experience is during professional development. We have learned that this can set some limits on the effective length of professional development programs. While teachers can engage in a range of activities, lack of classroom experience can limit the kinds of metacognitive or experience-based discussions that enrich PD programs. When offered a choice, we opt to have teachers attend a PD session, return to their classroom to try engineering with their students, and then return for a follow-up PD session. The follow-up session permits much richer discussion, rooted in experience, about the difficulties that they may have encountered and presents an opportunity for teacher sharing.

We have recognized that another way to potentially foster such conversations during a first professional development workshop would be to use video of engineering lessons from other classrooms or samples of student work. We are beginning to collect, compile, and annotate these.

Lack of Science Knowledge: Another challenge that surfaces during engineering PD is elementary teachers’ weak science knowledge. As EiE design challenges build upon science topics, teachers’ lack of knowledge may be more evident in our PD than in other programs. Preservice teacher programs often require minimal science course taking, and teachers who gravitate toward the elementary grades may do so to escape taking science and math courses. At present, science is not deemed an important enough subject in many elementary schools to allocate much time to its classroom practice. In PD, teachers’ weak science understandings often become evident. While our PD session often spur teachers to want to better understand the

science (see below), a challenge that we face is balancing how much of our (usually very limited) PD time we should or can devote to bolstering teachers' science knowledge.

Two-Role Tension: During professional development, teachers are balancing two roles: most instinctively they experience the workshop and its activities through the eyes of their students—they filter their experiences through a student lens, assessing whether their students could easily engage with the activities. However, professional development also usually aims to deepen teachers' knowledge of subject matter, pedagogical strategies, or pedagogical content knowledge. These outcomes require that teachers assume a second role as an adult learner or as a teacher. A tension can sometimes arise between the student and the teacher role and professional development facilitators need to consider both lenses when planning sessions. For example, one challenge surfaces when trying to determine at what level to present an engineering challenge. First grade teachers will find a problem more interesting and will develop deeper knowledge if they engage with a challenge designed for older (third-fifth grade) students instead of the version specifically tailored for first grade students. However, if this decision is not well-explained and if first-grade materials are not simultaneously available to peruse, teachers tend to focus on the fact that “my students could never do this activity” instead of understanding that their students are not meant to—that a simplified, more age-appropriate version is what they would actually use in the classroom.

We have found in professional development that we need to clearly articulate why we include sessions and activities without direct application to the classroom. Usually these include sessions designed to deepen teachers' knowledge and provide them with a broader understanding of or increased comfort with engineering, for example, guest presentations by practicing engineers about their work. If teachers clearly understand that these sessions are not necessarily intended to be ported back to their classrooms, that these are enrichment sections for *their* edification, they are more likely to appreciate and enjoy them.

Similarly, a tension exists between being immersed as a student and stepping out of the experience occasionally to reflect upon the teaching strategies. If a professional development session flows smoothly, participants can forget to note what devices are being employed to orchestrate the session, which can make implementing the activities in their own classrooms difficult. We have learned we must periodically pause during PD activities to ask teachers to step away from their role as students to reflect upon what facilitators are doing—for example, how materials are being managed, or the kinds of questions the “teacher” is asking. Session facilitators also use such breaks to lead discussions about common types of responses, questions, or mistakes students might make and brainstorm ideas about how to respond to these. These deliberate, reflective sessions help to equip teachers to facilitate the sessions once they return to their classrooms.

Although such a dual role tension exists in most PD, because engineering and its activities are so new for most teachers, it seems they tend to stay rooted as students for longer periods of time and need prompting to flip into reflective teacher mode. This tendency might also be due to the fact that they have not yet developed their own content-specific pedagogical tips they can share or use to compare to current techniques.

Still Developing “Teaching Tips”: Engineering is a new discipline. Therefore a corpus of “teaching tips” related to engineering is just beginning to come into existence. Teachers need time to try the new types of activities and then to apply their teaching expertise to create techniques, strategies, and helpful hints related to engineering in the classroom. Whenever possible, PD facilitators should have experienced teachers share their pedagogical strategies with participants. PD leaders also collect teachers’ advice and try to pass some of it along during workshop sessions.

As teachers develop their teaching skills and practices related to engineering, PD sessions will be able to incorporate their perspectives and expertise in the fabric of the program and develop a larger toolkit of tips to help seed engineering novice teachers’ efforts.

Lack of Transfer: Initially EiE staff thought that teachers or PD facilitators would choose to participate in one PD workshop (that focuses on one or two of our units) to become familiar with some basics of engineering and then would prefer to transfer this knowledge to additional units by themselves. This is not the case. Although the EiE units have been written to include the information needed to implement them in the classroom, teachers and PD facilitators much prefer to learn as part of a larger community. They spend money and time returning to professional development sessions specific to each of the units they plan to teach. Engagement in the engineering activities with colleagues and perhaps the sharing, reflection, and tips make the PD worthwhile for teachers. The challenge: offering many more PD sessions. We are beginning to explore whether some of these needs for unit-specific PD could be met with online or video resources or whether face-to-face interaction is truly the most important aspect of such PD.

Preservice: Working with inservice teachers is a necessary step to introducing engineering in classrooms. But it cannot be the only strategy. If engineering is to permeate elementary classrooms, professional development for this discipline needs to occur during preservice programs as well. Elementary engineering preservice education can be viewed as both a challenge and an opportunity. EiE is currently beginning to work with a range of preservice education faculty to explore the range of ways that engineering might be infused into already-packed programs. Integration into required courses in science and mathematics; infusion in methods, curriculum, and prepracticum courses; and inclusion in courses that focus on multicultural teaching, English language learners, and special needs students are all places where the EiE engineering materials are currently being tested. Simultaneously, we offer PD for practicing teachers whose classrooms will serve as observation and student teaching sites to try to reinforce future teachers’ experiences with engineering in a classroom setting. We hope to compile a series of case studies for how engineering may be taught to preservice teachers. Then the daunting task will become convincing college preservice education or science/math faculty to change their course offerings.

Opportunities

The introduction of engineering as a new discipline in elementary education also provides some unique professional development opportunities.

Modeling Engineering Instruction: The lack of exposure, experience, and education about engineering by elementary teachers presents a unique situation—teachers do not come with ingrained habits of teaching that need to be undone. Because the subject has almost never been taught at the elementary level, we can model what we think engineering instruction should look like. As elementary engineering has not had a history of reading, fact, or memorization-based instruction, instead of trying to correct bad habits or presenting alternative models for teaching, we can offer fresh, original perspectives rooted in our philosophy of how children should learn. The teachers have no other engineering experiences to fall back on, our materials are consistent with engaged, open-ended problem solving, and our professional development models the type of teaching that we envision in classrooms. Thus, instead of undoing existing habits and working with many competing instructional philosophies and paradigms, we have the chance to provide a strong, consistent model almost from scratch.

Bolstering Science Knowledge and Instruction: Over the past four years, the richness of the opportunity to strengthen and deepen teachers’ science knowledge and pedagogies through engineering PD has become increasingly apparent. As elementary teachers have not previously been asked or expected to teach engineering concepts, most are comfortable “not-knowing” in this discipline, and will readily admit what they do not know. This lies in stark contrast to science. Often elementary teachers feel that because they are supposed to teach elementary science, they should understand it. But they are often uncomfortable with it and their (lack of) knowledge. In science PD a type of dance often occurs around what teachers do and do not know.

Cast a problem that rests on science understanding as an engineering problem, however, and the conversation can open up. Teachers, often comfortable thinking that they are asking engineering questions, are, in fact, making science queries. Discussion and debate can flow and teachers can make the links between the science knowledge and how it is used in engineering. The links between science and engineering knowledge are so strong and the need for increased teacher knowledge about science is so necessary that we are currently developing and piloting a series of professional development programs that explicitly teach both science and engineering concepts.

Open-Ended Inquiry: In addition to providing a portal to deeper exploration of science knowledge, teachers regularly report that EiE engineering PD programs have also fundamentally changed the way they teach. Entering an engineering PD program, many teachers will respond that they teach open-ended, inquiry-based science. After engagement in open-ended engineering challenges during PD (for which an answer truly does not exist), teachers reflect that they did not previously understand what open-ended, inquiry-based learning really was or how it might be managed in the classroom. Many teachers report that their engineering PD experiences have fundamentally changed not only that they will teach engineering, but how they are teaching science. The engineering design process provides an organizing tool for problem solving in a range of disciplines. The experience of grappling with messiness, learning about classroom management strategies, and leading wrap-up discussions about open-ended problems with a plethora of potential solutions can drastically change how teachers view their previous teaching methods and how they return to teach in the classroom. This aspect of elementary engineering PD has been one of the most unexpected and powerful outcomes.

Transcendent Science and Engineering Themes: A number of core themes connect our EiE units. In longer (3-4 day) PD programs, a sequence of units can be knitted together to draw out fundamental understandings such as Energy, Systems, or Changes in the Earth. Engaging with both science and engineering activities and problems, teachers can develop deep knowledge of these themes that underlie science.

Workshop Length: Although intense, ongoing, and sustained professional development is the most effective and generally the goal, in many cases it is not currently a realistic possibility. While we know that programs that are multiple days across a number of months are richer, we can open the eyes of elementary teachers to a greater understanding of engineering and technology and the potential for doing engineering with their students in as little as two hours. For teachers who have a stronger background in teaching inquiry science, two hours can be all they need to begin experimenting with this new subject area in their classrooms. But we much prefer workshops that are double this length. EiE offers PD programs that are two, four, six, and eight hours and multiple days in length. All have resulted in teachers bringing engineering into their classes.

A Community of Learners: Early signs indicate that teachers prefer to experience EiE as part of a community. When given the option, even experienced engineering elementary educators seem to prefer to return to engage with materials in PD sessions with other learners rather than to work on their own. Somewhat surprisingly, early PD evaluation data suggest that, once they return to their schools, teachers also work to recruit other colleagues to form their own local network of engineering educators. Per teachers' request, we will begin to offer an online discussion site for teachers in the next month and explore how such a community of learners can be built and supported virtually.

Useful PD Outcomes and Products: Asking participants to demonstrate some of the results of their professional development by applying their learning is a common PD strategy. Often the award of teacher professional development credit is linked to production of a product. One clear outcome of an EiE PD session can be seeing teachers begin to infuse engineering and EiE lessons into their curriculum. However, more immediate, written products are frequently required, particularly in PD session of longer duration.

In thinking about how teacher application and reflection might be structured to benefit not only the individual but also the larger community of EiE teachers, we decided to have PD participants contribute to a database of online EiE Content Connections (<http://www.mos.org/eie/educatorresources/>). Content Connections are lessons, usually authored by teachers, which integrate EiE lessons with mathematics, social studies, language arts, and science. Teachers complete a web-based form describing the activity and submit it to a database of lessons that can be searched by other practitioners interested in how they could build upon an EiE lesson and integrate or reinforce a topic they are currently teaching (such as fractions or cultural norms of a specific country). If successful, this experimental system will not only capture the creativity and experiences of engineering teachers but will also provide a meaningful PD product that is immediately used by others.

Additional PD Resources: Additional resources will continue to strengthen and enrich our professional development. Teachers have asked for a series of multimedia resources that include video of the EiE lessons being taught in actual classrooms and of preparation and management of materials resources. They want to view these resources as reminder PD before they actually teach the lessons in their classrooms. Such video snippets could also provide a launch point for a discussion of pedagogical strategies or students' questions or conceptions during a PD session. In an annotated version these videos could also reside online as an additional PD resource. Teachers have wonderful suggestions about what would be most useful to them as they work to infuse engineering—we have an ongoing list and the opportunities for creating new supportive resources for face-to-face, online, or personal professional development definitely exist.

Elementary Differences

In offering engineering-based professional development for high school/middle school teachers and elementary teachers, we have observed some differences between secondary and elementary engineering and professional development. These include:

Focus on Process, Not Content: Engineering at the elementary-school level involves much less content than at the middle and high school level. Often we remark to teachers that they know most of the engineering content they need to teach to their elementary charges—they just haven't recognized it as such. "Common sense" understandings about properties of materials that most adults have developed through experience all need to be fostered, hopefully through experience, in young children.

The EiE program believes that the focus of elementary engineering should be primarily on process—most importantly, the engineering design process as a problem-solving tool. This overarching process also incorporates other skills such as asking relevant questions, brainstorming, observing and collecting data, analyzing data, communicating, and making data-based decisions. This more general process-based approach often carries over to science and mathematics. It need not encompass a great deal of new engineering content. This is one reason that it is often much easier to get elementary teachers engineering with their students than their colleagues who teach older grades (where content is often much more a focus).

Skills Consistent with Elementary Goals: Many of the skills that are developed and reinforced by engineering are consistent with those already emphasized in elementary schools. Persistence, team building, the value of critically examining failure, sharing, and keeping an open mind are all aspects of character development that teachers value and consciously strive to foster in elementary children and thus appreciate as part of engineering. In middle and high school, the explicit importance of such skills is much less often part of articulated in teaching goals.

Materials Matter: In general, it is much easier to get elementary teachers to participate in professional development than secondary teachers. Many do not expect financial compensation and welcome a small stipend. Perhaps more exciting than financial recompense for elementary teachers are teaching materials. When we have to make a choice, we generally equip teachers with curriculum materials—this catalyzes classroom use and means that teachers do not spend personal money on materials and time gathering supplies.

Openness to a New Discipline: Contrary to our initial beliefs, elementary teachers in general are much more open to integrating engineering into their courses than secondary science or mathematics teachers. One reason might be that most of them already teach a number of disciplines and therefore their professional identities are not so closely linked with one subject area. One of the biggest surprises we have experienced has been how readily these teachers incorporate engineering into their classes and then eagerly await more.

Next Steps

Over the past four years, the EiE team has learned much through experience and constant teacher feedback about how to structure and conduct face-to-face professional development programs. However, there is much more to learn in a number of different areas. We are continually expanding our understandings and learning from others using different curricular programs about which strategies, challenges, and opportunities can be generalized and which are more program or site-specific. Our team is constantly thinking about what kinds of resources we might develop to support ongoing teacher professional development—these might be resources that can be used during a professional development session (like video snippets of an elementary class doing engineering), or instead of or in addition to a face-to-face workshop session such as discussion boards or online resources.

In addition to inservice teacher education, the EiE team has begun to work with preservice teacher education, specifically with college faculty that teach courses to preservice teachers. Over the next few years working with faculty we hope to develop a number of models for how future elementary teachers might learn about engineering and technology concepts and how they can be integrated into their classes.

The EiE team is also increasingly thinking about professional development of professional development providers. How can the community of professional development providers continue to learn from one another about how to best offer professional development related to elementary engineering? We have begun to explore some models for a train-the-trainer and a community of learners approach to foster and share best practices.

Finally, having begun to distill strategies that seem to work well, we are starting to turn our attention toward creating a research program that investigates qualitatively and quantitatively the impact of EiE professional development programs on both teachers and students. Comparing various models and aspects to determine their relative impact might be a powerful contribution to the field.



Engineering is Elementary

Workshop Evaluation

Please rate how well this workshop prepared you to:

	Please explain your rating...							Would prefer to have spent...				
	Did not help at all	Helped slightly	Helped moderately	Helped a great deal	Less time	No change	More time					
Understand engineering/technology content, such as:												
What engineers do	1	2	3	4	5	6	7					
The engineering design process	1	2	3	4	5	6	7					
How science, technology, and engineering interrelate	1	2	3	4	5	6	7					
Implement an EiE unit:												
Manage preparation and materials	1	2	3	4	5	6	7					
Understand the content of the EiE unit	1	2	3	4	5	6	7					
Teach the lessons	1	2	3	4	5	6	7					
More broadly, understand how to teach engineering:												
Help students to understand what engineers do	1	2	3	4	5	6	7					
Help students to understand the engineering design process	1	2	3	4	5	6	7					
Manage students' design process in an open-ended way	1	2	3	4	5	6	7					
Assess students' engineering designs	1	2	3	4	5	6	7					
Develop your own engineering design challenges for students	1	2	3	4	5	6	7					

What was most worthwhile to you about today's workshop?

What aspects of today's workshop were least worthwhile?

Is there anything you would have preferred to spend time on?

What questions do you still have?

Other comments about today's workshop: